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ONEILL, KARIE AMBER	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)
	10/616,998	KIM, HAE-KYOUNG
	Examiner	Art Unit
	Karie O'Neill	1745

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 April 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-30* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-29* is/are rejected.

7)☒ Claim(s) *30* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. The Applicant's arguments filed on April 3, 2007, were received. None of the claims were amended. Claim 30 was added. Therefore, Claims 1-30 are pending this office action.

2. The text of those sections of Title 35, U.S.C. code not included in this action can be found in the prior Office Action issued on January 10, 2007.

Claim Rejections - 35 USC § 102

3. The rejection of Claims 1-3, 5, 7, 22-23 and 26-29 under 35 U.S.C. 102(b) as being anticipated by Chen et al. (US 6,410,142 B1) is maintained. The rejection is repeated below for convenience.

With regard to Claim 1, Chen et al. disclose a nanocomposite membrane comprising: a polymer called syndiostatic polystyrene (sps) having cation exchange groups; and a layered clay or silicate material uniformly dispersed in the polymer matrix, said layered clay or silicate material being intercalated with the polymer (column 2 lines 14-21).

With regard to Claim 2, Chen et al. disclose wherein the silicate or clay is selected from the group consisting of smectite, vermiculite, halloysite, sericite, mica, and a mixture of the foregoing materials (column 2 lines 65-67).

With respect to Claim 3, Chen et al. disclose the silicate comprising smectite and the smectite being selected from the group consisting of montmorillonite, saponite,

beidellite, nontronite, hectorite, and stevensite, and a mixture of the foregoing materials (column 2 lines 65-67).

With regard to Claim 5, Chen et al. disclose the amount of silicate particles in a range from about 0.1 to 40 parts by weight per 100 parts by weight of the polymer matrix (column 2 lines 40-44).

With regard to Claim 7, Chen et al. disclose wherein the polymer with cation exchange groups is styrene monomer (column 1 line 65).

With regard to Claims 22 and 23, Chen et al. disclose wherein the membrane further comprises a cationic surfactant, wherein the cationic surfactant comprises organic onium cations (column 3 lines 10-13), wherein the organic onium cations comprise n-hexadecyl trimethylammonium bromide and cetylpyridium chloride (column 3 lines 15-16).

With regard to Claim 26, Chen et al. disclose a nanocomposite membrane comprising: a polymer called syndiostatic polystyrene (sps) having cation exchange groups; and a layered clay or silicate material uniformly dispersed in the polymer matrix (column 2 lines 14-21); and cationic surfactant adsorbed within the silicate nanoparticles (column 2 lines 54-57).

With regard to Claims 27 and 28, Chen et al. disclose wherein the membrane further comprises a cationic surfactant, wherein the cationic surfactant comprises organic onium cations (column 3 lines 10-13), wherein the organic onium cations comprise n-hexadecyl trimethylammonium bromide and cetylpyridium chloride (column 3 lines 15-16).

With regard to Claim 29, Chen et al. disclose a method of forming a nanocomposite membrane, comprising: mixing silicate nanoparticles with surfactant, water and a polymer having cation exchange groups, and drying the mixture to form the nanocomposite membrane (see Example 1).

Claim Rejections - 35 USC § 103

4. The rejection of Claim 4 under 35 U.S.C. 103(a) as being unpatentable over Chen et al. (US 6,410,142 B1), as applied to Claims 1-3, 5, 7, 22-23 and 26-29, and in further view of Blanton et al. (US 6,555,610 B1) is maintained. The rejection is repeated below for convenience.

Chen et al. disclose the nanocomposite in paragraph 3 above, but do not disclose the silicate nanoparticles having an average diameter of 1-100nm.

Blanton et al. disclose a nanocomposite material in which one of the components is of the order less than 400 nanometers and the silica clay material belongs to the group of smectites and montmorillonites (column 4 lines 61-66) comprising particles of a lateral dimension between 0.01μm and 10μm which is in the range of 1-100nm (column 5 lines 15-19). Therefore, at the time of the invention it would have been obvious to one of ordinary skill in the art to use a clay or silicate with specific dimensions with the nanocomposite of Chen et al., because Blanton et al. teach improving the mechanical properties of membranes with these specific dimensions (column 4 line 18).

5. The rejection of Claim 8 under 35 U.S.C. 103(a) as being unpatentable over Chen et al. (US 6,410,142 B1), as applied to Claims 1-3, 5, 7, 22-23 and 26-29, and in further view of Grot et al. (US 5,919,583) is maintained. The rejection is repeated below for convenience.

Chen et al. disclose the nanocomposite in paragraph 3 above, but do not disclose the polymer cation group as being a highly fluorinated polymer with sulfonate groups as proton exchange groups at terminals of side chains and containing fluorine atoms that amount to at least 90% of the total number of fluorine and hydrogen atoms bound to carbon atoms of the backbone side chains of the polymer.

Grot et al. disclose cation exchange groups consisting of sulfonate, carboxylate, phosphate, imide, sulfonamide and sulfonamide groups, further including copolymers of trifluoroethyene, tetrafluoroethylene, styrene-divinyl benzene, and, α,β,β-trifluorostyrene, a polymer backbone which is highly fluorinated and the ion exchange groups are sulfonate groups and at least 90% of the total number of halogen and hydrogen atoms are fluorine atoms (column 3 lines 33-37 and 55-61). Therefore, at the time of the invention it would have been obvious to one of ordinary skill in the art to combine the cation exchange groups with the nanocomposite of Chen et al., because Grot et al. teach increasing the transport of protons across the membrane and for enhanced mechanical properties such as increased stiffness (column 3 lines 2 and 30-31).

6. The rejection of Claims 6, 9, 10, 14-15, 17-19, 21 and 24-25 under 35 U.S.C. 103(a) as being unpatentable over Chen et al. (US 6,410,142 B1), as applied to Claims 1-3, 5, 7, 22-23 and 26-29, and in further view of Taft , III et al. (US 6,630,265 B1) are maintained. The rejection is repeated below for convenience.

Chen et al. disclose the nanocomposite in paragraph 3 above, but do not disclose the cation exchange groups of the polymer being selected from the group consisting of a sulfonate acid group, a carboxyl group, a phosphoric acid group, an imide group, a sulfonamide group, a sulfonamide group and a hydroxyl group, the nanocomposite membrane having a thickness of 30-200μm, and a fuel cell comprising an anode, cathode having the nanocomposite membrane interposed between the anode and cathode.

With regard to Claims 6 and 18, Taft et al. disclose the cation exchange groups of the polymer being selected from the group consisting of sulfate, phosphate or carbonate groups (column 6 lines 17-19). Therefore, at the time of the invention it would have been obvious to one of ordinary skill in the art to use the above polymer containing the specific cation exchange groups with the nanocomposite of Chen et al., because Taft et al. teach these polymers increasing the mechanical strength of the nanocomposite and increasing the proton conductivity during electrochemical cell operation (column 6 lines 17-19).

With regard to Claims 9 and 21, Taft et al. disclose the nanocomposite membrane having a thickness ranging from about 10μm to 200μm and preferably from about 45μm to 100μm (column 6 lines 42-45). Therefore, at the time of the invention it

would have been obvious to one of ordinary skill in the art to use the polymer having a specific thickness with the nanocomposite of Chen et al., because Taft et al. teach the membrane being physically robust enough to withstand manufacturing processes and pressure differentials within the stack and so as not degrade in the stack environment (column 6 lines 51-58).

With regard to Claim 10, Taft et al. disclose a fuel cell comprising a cathode where a reduction of an oxidizing agent occurs, an anode where oxidation of fuel occurs and the nanocomposite electrolyte membrane interposed between the anode and cathode (column 6 lines 62-67 and column 7 lines 1-9). Therefore, at the time of the invention it would have been obvious to one of ordinary skill in the art to use the nanocomposite of Chen et al. interposed between the anode and cathode of a fuel cell, because Taft et al. teach the nanocomposite membrane being comparable to Nafion, Nafion typically being used as a membrane in fuel cells, and the nanocomposite exhibiting higher proton conductivity at elevated temperatures, greater mechanical strength, and higher ion exchange capacity (column 6 lines 49-58).

With regard to Claim 14, Chen et al. disclose wherein the silicate or clay is selected from the group consisting of smectite, vermiculite, halloysite, sericite, mica, and a mixture of the foregoing materials (column 2 lines 65-67).

With respect to Claim 15, Chen et al. disclose the silicate comprising smectite and the smectite being selected from the group consisting of montmorillonite, saponite, beidellite, nontronite, hectorite, and stevensite, and a mixture of the foregoing materials (column 2 lines 65-67).

With regard to Claim 17, Chen et al. disclose the amount of silicate particles in a range from about 0.1 to 40 parts by weight per 100 parts by weight of the polymer matrix (column 2 lines 40-44).

With regard to Claim 19, Chen et al. disclose wherein the polymer with cation exchange groups is styrene monomer (column 1 line 65).

With regard to Claims 24 and 25, Chen et al. disclose wherein the membrane further comprises a cationic surfactant, wherein the cationic surfactant comprises organic onium cations (column 3 lines 10-13), wherein the organic onium cations comprise n-hexadecyl trimethylammonium bromide and cetylpyridium chloride (column 3 lines 15-16).

7. The rejection of Claims 11-13 under 35 U.S.C. 103(a) as being unpatentable over Chen et al. (US 6,410,142 B1) and Taft, III et al. (US 6,630,265 B1), as applied to Claims 1-3, 5-7, 9, 10, 14, 15, 17-19 and 21-29 above, and in further view of Yen et al. (US 5,795,496) are maintained. The rejection is repeated below for convenience.

Chen et al. and Taft et al. disclose the fuel cell in paragraph 6 above, but do not disclose the cathode and anode are comprising catalyst layers containing carbon supported platinum catalysts, and the anode further comprising a platinum-ruthenium catalyst.

Yen et al. discloses an anode formed from platinum-ruthenium alloy particles dispersed in high surface area carbon (column 3 lines 32-34) and a cathode in which platinum particles are bonded to a carbon backing material (column 3 lines 57-58).

Therefore, at the time of the invention it would have been obvious to one of ordinary skill in the art to use the specific anode and cathode materials above with the fuel cell of Chen et al. and Taft et al., because Yen et al. teach these catalyst containing anodes and cathodes providing more efficient electro-oxidation (column 3 line 55).

8. The rejection of Claim 16 under 35 U.S.C. 103(a) as being unpatentable over Chen et al. (US 6,410,142 B1) and Taft , III et al. (US 6,630,265 B1), as applied to Claims 1-3, 5-7, 9, 10, 14, 15, 17-19 and 21-29 above, and in further view of Blanton et al. (US 6,555,610 B1) is maintained. The rejection is repeated below for convenience.

Chen et al. and Taft et al. disclose the fuel cell in paragraph 6 above, but do not disclose wherein the silicate nanoparticles have an average diameter of 1-100 nm.

Blanton et al. disclose a nanocomposite material in which one of the components is of the order less than 400 nanometers and the silica clay material belongs to the group of smectites and montmorillonites (column 4 lines 61-66) comprising particles of a lateral dimension between 0.01μm and 10μm which is in the range of 1-100nm (column 5 lines 15-19). Therefore, at the time of the invention it would have been obvious to one of ordinary skill in the art to use a clay or silicate with specific dimensions with the nanocomposite of Chen et al. and Taft et al., because Blanton et al. teach improving the mechanical properties of membranes with these specific dimensions (column 4 line 18).

9. The rejection of Claim 20 under 35 U.S.C. 103(a) as being unpatentable over Chen et al. (US 6,410,142 B1) and Taft, III et al. (US 6,630,265 B1), as applied to Claims 1-3, 5-7, 9, 10, 14, 15, 17-19 and 21-29 above, and in further view of Grot et al. (US 5,919,583) is maintained. The rejection is repeated below for convenience.

Chen et al. and Taft et al. disclose the fuel cell in paragraph 6 above, but do not disclose the polymer cation group as being a highly fluorinated polymer with sulfonate groups as proton exchange groups at terminals of side chains and containing fluorine atoms that amount to at least 90% of the total number of fluorine and hydrogen atoms bound to carbon atoms of the backbone side chains of the polymer.

Grot et al. disclose cation exchange groups consisting of sulfonate, carboxylate, phosphate, imide, sulfonamide and sulfonamide groups, further including copolymers of trifluoroethyene, tetrafluoroethylene, styrene-divinyl benzene, and, α,β,β-trifluorostyrene, a polymer backbone which is highly fluorinated and the ion exchange groups are sulfonate groups and at least 90% of the total number of halogen and hydrogen atoms are fluorine atoms (column 3 lines 33-37 and 55-61). Therefore, at the time of the invention it would have been obvious to one of ordinary skill in the art to combine the cation exchange groups with the fuel cell of Chen et al. and Taft et al., because Grot et al. teach increasing the transport of protons across the membrane and for enhanced mechanical properties such as increased stiffness (column 3 lines 2 and 30-31).

Allowable Subject Matter

10. Claim 30 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

11. The following is a statement of reasons for the indication of allowable subject matter: the closest prior art, Chen (US 6,410,142), does not teach or fairly suggest the polymer having cation exchange groups comprises: a homopolymer derived from monomers having the formula of $MSO_2CFR_fCF_2O[CFYCF_2O]_nCF=CF_2$ and a copolymer derived from the monomers of the formula above and at least one monomer selected from the group consisting of ethylene, halogenated ethylene, perfluorinatedα-olefin, perfluoroalkylvinyl ether, wherein R_f is a radical selected from fluorine and a C_1-C_{10} perfluoroalkyl group; Y is a radical selected from fluorine and a trifluoromethyl group; n is an integer from 1 to 3; and M is a radical selected from fluorine, a hydroxyl group, an amino group, and a -OMe where Me is a radical selected from alkaline metal and a quaternary ammonium group; a polymer having the carbon backbone substantially substituted with fluorine and pendant groups having the formula of $-O-[CFR'_f]_b[CFR_f]_aSO_3Y$ where a is an integer from 0 to 3; b is an integer from 0 to 3; a+b is greater than or equal to 1; R_f and R'_f are independently selected from halogen atom and a substantially fluorinated alkyl group; and Y is hydrogen or alkaline metal; or a sulfonic fluoropolymer having the fluorinated backbone and pendent groups having the formula of $ZSO_2-[CF_2]_a-[CFR_f]_b$ -O- where Z is halogen, alkaline metal, hydrogen, or -OR where R is a C_1-C_{10} alkyl or aryl radical; a is an integer from 0 to 2; b is an integer

from 0 to 2; a+b is not equal to zero; and R_f is selected from fluorine, chlorine, a C_1-C_{10} perfluoroalkyl group, and a C_1-C_{10} fluorochloroalkyl group.

Response to Arguments

12. Applicant's arguments filed April 3, 2007, have been fully considered but they are not persuasive.

Applicant's principal arguments are:

(a) Chen fails to disclose a membrane.

(b) Chem fails to disclose the polymer having cation exchange groups.

(c) Chen fails to disclose a nanocomposite electrolyte membrane for a fuel cell.

In response to Applicant's arguments, please consider the following comments:

(a) Chen states in column 3 lines 60-63, that the composite materials of the invention may be directly injection-molded, extrusion-molded or compression-molded, making them into a membrane type material.

(b) Chen discloses the polymer matrix containing syndiostatic polystyrene (sps). In the instant application, on pages 5-6, examples of a polymer with cation exchange groups include a homopolymer and a copolymer made from styrenes, several other materials, a derivative of the homopolymers and the copolymers, and a mixture of the foregoing polymers.

(c) The language "for a fuel cell" is considered intended use and is given little to no patentable weight. The invention of Chen is related to a nanocomposite

material, which is the same as that of Claim 1, making Chen and the instant application analogous art.

Conclusion

13. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Karie O'Neill whose telephone number is (571) 272-8614. The examiner can normally be reached on Monday through Friday from 8am to 5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached on (571) 272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Karie O'Neill
Examiner
Art Unit 1745

KAO

DAH-WEI YUAN
PRIMARY EXAMINER